

Application Serial No. 10/720,380

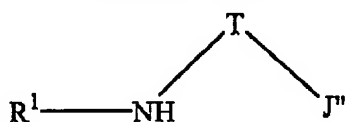
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AMENDMENTS TO THE CLAIMS

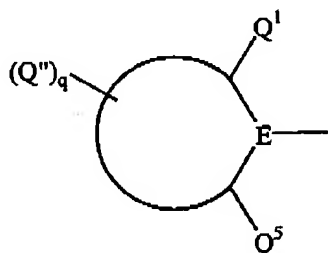
Claims 1-30. (previously canceled)

31. (Previously presented) A process for the stereospecific polymerization of an alpha-olefin, comprising polymerizing at least one alpha-olefin in the presence of a catalyst composition, optionally in the presence of one or more activators, under polymerization conditions, wherein the catalyst composition is formed from a mixture which comprises:

(1) a ligand characterized by the following general formula:



wherein R^1 is characterized by the general formula:



wherein E is either carbon or nitrogen,

Q^1 and Q^5 are substituents on the R^1 ring at a position ortho to E, with Q^1 and Q^5 are independently selected from the group consisting of alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl and silyl, but provided that Q^1 and Q^5 are not both methyl;

Q''_q represents additional possible substituents on the ring, with q being 1, 2, 3, 4 or 5 and Q'' being selected from the group consisting of hydrogen, alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, heteroalkyl, substituted heteroalkyl, heterocycloalkyl, substituted heterocycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkoxyl, aryloxy, silyl, boryl, phosphino, amino, thio, seleno, halide, nitro, and combinations thereof;

T is a bridging group selected group consisting of $-\text{CR}^2\text{R}^3-$ and $-\text{SiR}^2\text{R}^3-$ with R^2 selected from the group consisting of hydrogen, alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, heteroalkyl, substituted heteroalkyl, heterocycloalkyl, substituted heterocycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkoxyl, aryloxy, silyl, boryl, phosphino,

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amino, thio, seleno, halide, nitro, and combinations thereof; R^3 selected from the group consisting of aryl, substituted aryl, heteroaryl, and substituted heteroaryl; and provided that R^2 is different from R^3 ;

J" is selected from the group consisting of heteroaryl and substituted heteroaryl;

(2) a metal precursor compound characterized by the general formula $M(L)_n$ wherein M is either hafnium or zirconium and each L is independently selected from the group consisting of halide, alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, heteroalkyl, substituted heteroalkyl, heterocycloalkyl, substituted heterocycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkoxy, aryloxy, hydroxy, boryl, silyl, amino, amine, hydrido, allyl, diene, seleno, phosphino, phosphine, carboxylates, thio, 1,3-dionates, oxalates, carbonates, nitrates, sulphates, ethers, thioethers and combinations thereof or optionally two or more L groups are joined into a ring structure; n is 1, 2, 3, 4, 5, or 6; and

3) optionally, at least one activator.

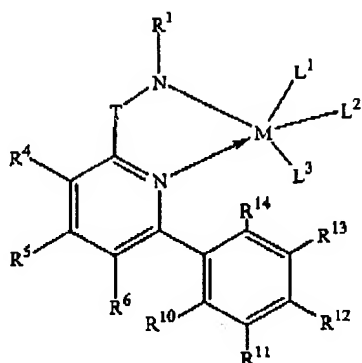
32. (Original) The process of claim 31, wherein said alpha olefin is propylene.

33. (Previously presented) The process of claim 31, further comprising providing a reactor with at least one polymerizable monomer and providing the catalyst composition or mixture to said reactor.

Claims 34-52. (previously cancelled).

53. (Original) A process for polymerizing propylene to crystalline polypropylene in a solution process, comprising contacting propylene monomer with a catalyst comprising a metal-ligand complex combined with an activator, combination of activators or activating technique, wherein at least one of said activators is a group 13 reagent and said metal-ligand complex is characterized by the formula:

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where M is zirconium or hafnium;

L^1 , L^2 , and L^3 are independently selected from the group consisting of halide, alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, heteroalkyl, substituted heteroalkyl, heterocycloalkyl, substituted heterocycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkoxy, aryloxy, hydroxy, boryl, silyl, amino, amine, hydrido, allyl, diene, seleno, phosphino, phosphine, carboxylates, thio, 1,3-dionates, oxalates, carbonates, nitrates, sulphates, ethers, thioethers and combinations thereof or optionally two or more L groups are joined into a ring structure;

R^1 is selected from the group consisting of 2,6-(Pr^j)₂-C₆H₃-; 2- Pr^j -6-Me-C₆H₃-; 2,6-Et₂-C₆H₃-; or 2-sec-butyl-6-Et-C₆H₃-;

T is a bridging group selected group consisting of $-CR^2R^3-$ and $-SiR^2R^3-$

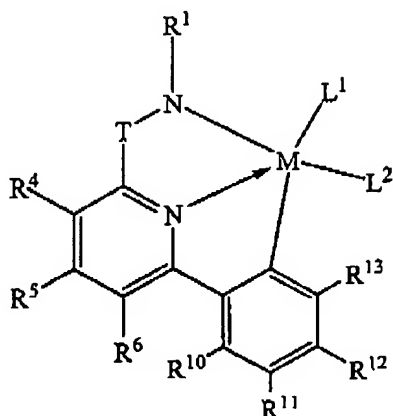
R^3 is selected from the group consisting of aryl and substituted aryl;

R^2 , R^4 , R^5 and R^6 are hydrogen;

either R^{10} , R^{11} , R^{12} , R^{13} , are each hydrogen; or one or more of R^{10} , R^{11} , R^{12} , R^{13} are methyl, fluoro, trifluoromethyl, methoxy, or dimethylamino; or R^{10} and R^{11} are joined to form a benzene ring and R^{12} and R^{13} are each hydrogen; and R^{14} is either hydrogen or methyl.

54. (Original) A process for polymerizing propylene to crystalline polypropylene in a solution process, comprising contacting propylene monomer with a catalyst comprising a metal-ligand complex combined with an activator, combination of activators or activating technique, wherein at least one of said activators is a group 13 reagent and said metal-ligand complex is characterized by the formula:

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where M is zirconium or hafnium;

L^1 and L^2 are independently selected from the group consisting of halide, alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, heteroalkyl, substituted heteroalkyl, heterocycloalkyl, substituted heterocycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkoxy, aryloxy, hydroxy, boryl, silyl, amino, amine, hydrido, allyl, diene, seleno, phosphino, phosphine, carboxylates, thio, 1,3-dionates, oxalates, carbonates, nitrates, sulphates, ethers, thioethers and combinations thereof or optionally the two L groups are joined into a ring structure;

R^1 is selected from the group consisting of $2,6(\text{Pr}^i)_2\text{-C}_6\text{H}_3\text{-}$; $2\text{-Pr}^i\text{-6-Me-C}_6\text{H}_3\text{-}$; $2,6\text{-Et}_2\text{-C}_6\text{H}_3\text{-}$; or $2\text{-sec-butyl-6-Et-C}_6\text{H}_3\text{-}$;

T is a bridging group selected group consisting of $\text{-CR}^2\text{R}^3\text{-}$ and $\text{-SiR}^2\text{R}^3\text{-}$;

R^3 is selected from the group consisting of aryl and substituted aryl;

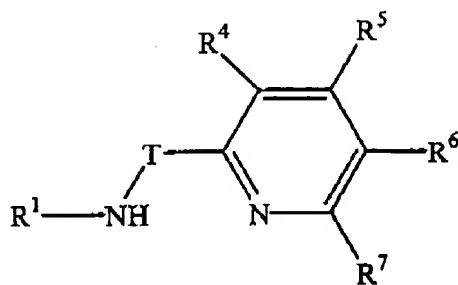
R^2 , R^4 , R^5 and R^6 are hydrogen; and

either R^{10} , R^{11} , R^{12} , R^{13} are each hydrogen; or one or more of R^{10} , R^{11} , R^{12} , R^{13} are methyl, fluoro, trifluoromethyl, methoxy, or dimethylamino; or R^{10} and R^{11} are joined to form a benzene ring and R^{12} and R^{13} are each hydrogen.

55. (Previously presented) The process of claim 31, wherein R^2 is hydrogen.

56. (Presently amended) The process of claim 31, wherein the ligand is characterized by the

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formula:

wherein R¹ and T are as defined above and R⁷ is independently selected from the group consisting of hydrogen, alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, heteroalkyl, substituted heteroalkyl, heterocycloalkyl, substituted heterocycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkoxy, aryloxy, silyl, boryl, phosphino, amino, thio, seleno, halide, and nitro, and each of R⁴, R⁵ and R⁶ is hydrogen.

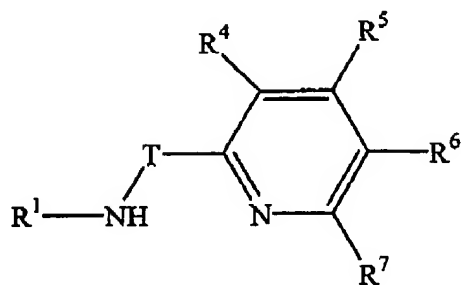
57. (Previously presented) The process of claim 56, wherein R³ is selected from the group consisting of benzyl, phenyl, naphthyl, 2-biphenyl, 2-dimethylaminophenyl, 2-methoxyphenyl, anthracenyl, mesityl, 2-pyridyl, 3,5-dimethylphenyl, o-tolyl, and phenanthrenyl.

58. (Previously presented) The process of claim 57, wherein Q¹ and Q⁵ are both isopropyl; or both ethyl; or both sec-butyl; or Q¹ is methyl and Q⁵ is isopropyl; or Q¹ is ethyl and Q⁵ is sec-butyl.

59. (Previously presented) The process of claim 58, wherein R¹⁰, R¹¹, R¹², R¹³ are each hydrogen; or one or more of R¹⁰, R¹¹, R¹², R¹³ are methyl, fluoro, trifluoromethyl, methoxy, or dimethylamino; or R¹⁰ and R¹¹ are joined to form a benzene ring and R¹² and R¹³ are each hydrogen.

60. (Presently amended) The process of claim 31, wherein the ligand is characterized by the

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formula:

wherein R¹ and T are as defined above and R⁷ is independently selected from the group consisting of hydrogen, alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, heteroalkyl, substituted heteroalkyl, heterocycloalkyl, substituted heterocycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, alkoxy, aryloxy, silyl, boryl, phosphino, amino, thio, seleno, halide, and nitro, and each of R⁴ and R⁵ is hydrogen and R⁶ is either hydrogen or is joined to R⁷ to form a fused ring system.

61. (Presently amended) The process of claim 60 [31], wherein R³ is selected from the group consisting of benzyl, phenyl, naphthyl, 2-biphenyl, 2-dimethylaminophenyl, 2-methoxyphenyl, anthracenyl, mesityl, 2-pyridyl, 3,5-dimethylphenyl, o-tolyl, and phenanthrenyl.

62. (Presently amended) The process of claim 61 [31], wherein Q¹ and Q⁵ are, independently, selected from the group consisting of -CH²R¹⁵, -CHR¹⁶R¹⁷ and methyl, provided that not both Q¹ and Q⁵ are methyl, wherein R¹⁵ is selected from the group consisting of alkyl, substituted alkyl, aryl and substituted aryl; R¹⁶ and R¹⁷ are independently selected from the group consisting of alkyl, substituted alkyl, aryl and substituted aryl; and optionally R¹⁶ and R¹⁷ are joined together in a ring structure having from 3-50 non-hydrogen atoms.

63. (Previously presented) The process of claim 62, wherein Q², Q³, and Q⁴ are each hydrogen and Q¹ and Q⁵ are both isopropyl; or both ethyl; or both sec-butyl; or Q¹ is methyl and Q⁵ is isopropyl; or Q¹ is ethyl and Q⁵ is sec-butyl.

64. (Previously presented) The process of claim 31, wherein R¹ or the variables Q¹, Q², Q³, Q⁴ and Q⁵ are chosen so that the R¹ moiety is selected from the group consisting of 2,6-(Pri)₂-C₆H₃-; 2-Pri-6-Me-C₆H₃-; 2,6-Et₂-C₆H₃-; and 2-sec-butyl-6-Et-C₆H₃-.

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Claims 65-66. (previously cancelled.)

67. (Presently cancelled) The process of claim 34, wherein R^{10} , R^{11} , R^{12} , R^{13} are each hydrogen; or one or more of R^{10} , R^{11} , R^{12} , R^{13} are methyl, fluoro, trifluoromethyl, methoxy, or dimethylamino; or R^{10} and R^{11} are joined to form a benzene ring and R^{12} and R^{13} are each hydrogen.

68. (Presently cancelled) The process of claim 32, wherein two or more of R^4 , R^5 , R^6 and R^7 are joined to form a fused ring system having from 3-50 non-hydrogen atoms in addition to the pyridine ring and/or R^4 , R^5 and R^6 are each independently selected from the group consisting of alkyl, aryl, halide, alkoxy, aryloxy, amino, and thio.

69. (Presently cancelled) The process of claim 34, wherein R^6 and R^{10} are joined to form a ring system having from 5-50 non-hydrogen atoms.

70. (Previously presented) The process of Claim 54 which further comprises recovering isotactic polypropylene, wherein the process is characterized in that when the temperature of the process is varied from a temperature below 90°C to a temperature above 100°C, a tacticity index value of the recovered isotactic polypropylene does not vary by more than 0.1 and a melting point of the recovered isotactic polypropylene does not vary by more than 10°C.

71. (Previously presented) The process of Claim 54 which further comprises recovering isotactic polypropylene having a weight average molecular weight of at least 100,000, wherein the process is characterized in that the melting point of the polypropylene does not vary by more than 10°C when the temperature of the solution process is varied from a temperature below 90°C to a temperature above 100°C.

72. (Previously presented) A process for producing isotactic polypropylene comprising polymerizing propylene, in the presence of a non-metallocene polymerization catalyst that comprises Hf or Zr, under solution polymerization process conditions including a temperature of

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the solution process, and producing a polypropylene which is characterized by a tacticity index value which does not vary by more than 0.1 when the temperature of the solution process is varied from a temperature below 90°C to a temperature above 100°C.

73. (Previously presented) A polymerization process for producing isotactic polypropylene, comprising polymerizing propylene, in the presence of a non-metallocene catalyst that comprises Hf or Zr, under solution polymerization process conditions including a temperature of the solution process, and producing polypropylene which is characterized by a melting point which does not vary by more than 10°C when the temperature of the solution process is varied from a temperature below 90°C to a temperature above 100°C.

74. (Previously presented) A process for producing isotactic polypropylene comprising polymerizing propylene, in the presence of a non-metallocene catalyst that comprises Hf or Zr, under solution polymerization process conditions including a temperature of at least 110°C and producing polypropylene which has a weight average molecular weight of at least 100,000.

Claim 75. (previously cancelled.)